

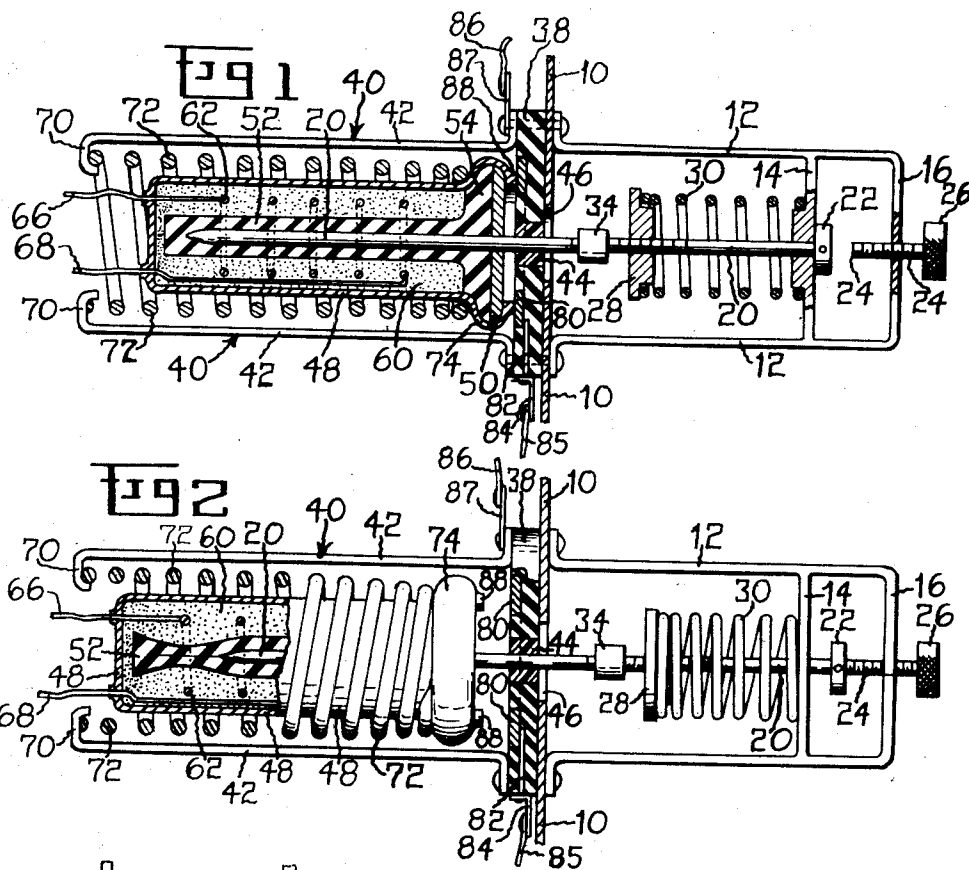
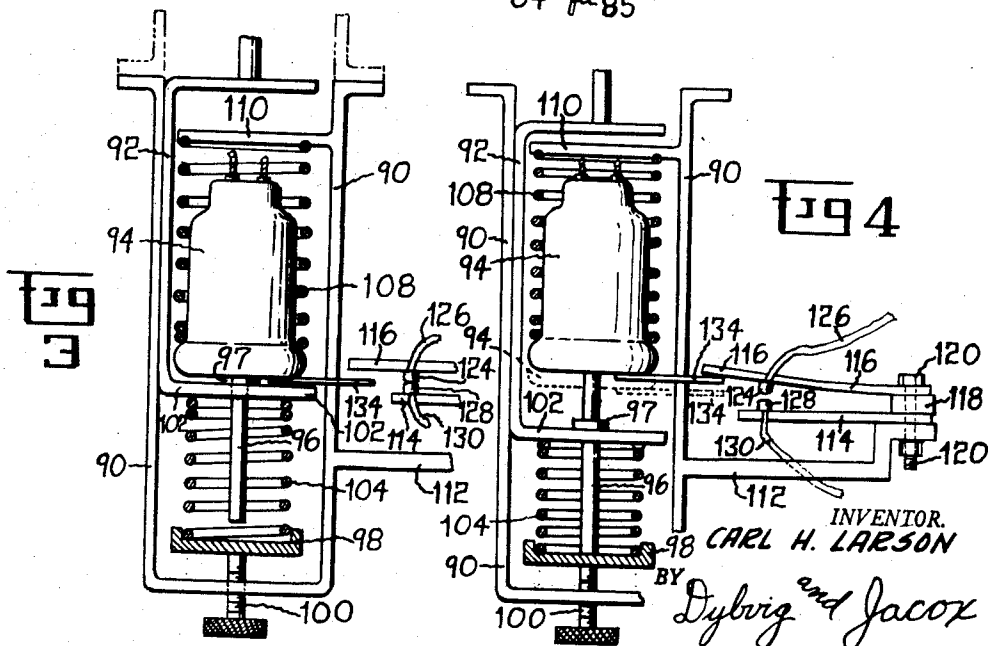
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SWITCH MECHANISM

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SWITCH MECHANISM

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This invention relates to a switch mechanism.

An object of this invention is to provide a switch mechanism which is adapted to operate in response to changes in temperature or changes in electrical voltage or current.

Another object of this invention is to provide such a switch mechanism which has a high degree of accuracy in the operation thereof.

Another object of this invention is to provide such a switch mechanism which may be readily and easily adjusted to operate at various values.

Another object of this invention is to provide a switch mechanism responsive to changes in temperature which switch mechanism has means for prevention of damage thereto if subjected to temperatures above the normal operating values thereof.

Another object of this invention is to provide a switch mechanism which may be sturdily built and which is long lived.

Other objects and advantages reside in the construction of parts, the combination thereof, the method of manufacture, and the mode of operation, as will become more apparent from the following description.

In the drawing:

Figure 1 is an elevational view with parts shown in section of a switch mechanism of this invention.

Figure 2 is an elevational view, similar to that of Figure 1, showing the switch mechanism in an operating position thereof.

Figure 3 is an elevational view of a preferred modification of a switch mechanism of this invention.

Figure 4 is an elevational view, similar to that of Figure 3, showing the preferred modification of the switch mechanism of this invention in an operating position thereof.

Referring to the drawing in detail, a switch mechanism of this invention comprises a support plate 10 to which is rigidly attached a bracket 12. The bracket 12 has a transverse member 14 and a transverse member 16. The transverse member 14 is provided with an aperture through which a rod member 20 is axially movable. The rod member 20 is provided with a head 22 which is disposed between the transverse members 14 and 16.

Threadedly attached to the transverse member 16 normal thereto is an elongate screw member 24 provided with a head 26. Upon axial movement of the rod member 20 toward the transverse member 16, the head 22 of the rod member 20 engages the screw 24, limiting movement of the rod member 20.

A nut 28 is threadedly attached to the rod member 20 intermediate the support plate 10 and the transverse member 14. A helical spring 30 encircles the rod member 20 and is compressed between the nut 28 and the transverse member 14. Obviously, adjustment of the position of the nut 28 changes the amount of compression of the spring 30. The helical spring 30 thus urges the rod member 20 to move in a direction from the

transverse member 14 so that the head 22 of the rod member 20 is normally in engagement with the transverse member 14.

An auxiliary nut 34 is threadedly attached to the rod member 20 adjacent the nut 28 and may serve to limit the adjusted position of the nut 28 upon the rod member 20.

An insulator member 38 is attached to the support plate 10 in engagement with the surface thereof opposite the bracket 12. The insulator member 38 is retained between the support plate 10 and a spring retainer 40 which is provided with legs 42. Imbedded within the insulator member 38 is a bearing member 44 which is in alignment with an aperture 46 of the support plate 10.

The rod member 20 extends through the aperture 46 of the support plate 10 and through the bearing member 44. The bearing member 44 and the transverse member 14 slidably retain the rod member 20 for axial movement thereof.

The rod member 20 extends into a container 48 which is provided with a rigid end wall 50 through which the rod member 20 is slidably movable. The portion of the rod member 20 within the container 48 is snugly disposed in a cavity within an elastic body 52. The elastic body 52 is preferably of rubber material or synthetic material or the like having the qualities of being substantially incompressible but elastic, permitting flow of the material. The elastic body 52 is provided with a sealing flange 54 which is in engagement with the end wall 50.

Within the container 48 encompassing the elastic body 52 is a body of thermal responsive expansible-contractible material 60. This thermal responsive expansible-contractible material 60 may be any element or any combination of elements, such as wax or the like, giving the material the physical property characteristics of a high coefficient of expansion over a given temperature range. A material is selected to provide the desired expansion and flow characteristics over the desired temperature range for a given application of the switch mechanism.

The container 48 and the contents thereof may be similar to that shown and described in copending application Serial No. 333,707, now Patent No. 2,806,375, which is assigned to the assignee of this application.

Imbedded within the thermal responsive material 60 within the container 48 is an electric heater element 62 which may be used to apply heat to the thermal responsive material 60. The electric heater element 62 is shown as being provided with connection leads 66 and 68 which extend through an end wall of the container 48 and are insulated from the container 48 in any suitable manner.

A helical spring 72 encircles the container 48 and engages a flared portion 74 of the container 48 adjacent the end wall 50. The helical spring 72 is compressed between the flared portion 74 and arcuate end portions 70 of the legs 42 of the spring retainer 40. Thus, the container 48 is resiliently urged toward the insulator member 38. Imbedded within the insulator member 38 at the surface thereof engageable by the container 48 is a conductor plate or ring 80 to which is electrically connected a conductor 82 which is also imbedded within the insulator member 38. A connection lug 84 is electrically connected to the end of the conductor 82 for attachment to an external lead 85. Another external lead 86 is attached to a connector lug 87 which is secured to the spring retainer 40.

The container 48 is constructed of metallic electric conductor material of any suitable type such as copper, aluminum, steel, and the like.

Thus, it is understood that when the container 48 is in

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engagement with the conductor ring 80, as shown in Figure 1, an electric circuit exists from the external lead 85, through the connection lug 84, through the conductor 82, through the conductor ring 80, through the container 48, through the spring 72, through the spring retainer 40, through the connector lug 87, and to the external lead 86. If desired, the flared end 74 of the container 48 may be provided with contact protuberances 88 for engagement with the conductor ring 80.

Operation

It is to be understood that heat may be applied directly to the thermal responsive expansible-contractible material 60 by means of the electric heater element 62 by connection of the connection leads 66 and 68 to a source of electrical energy. Heat may also be applied to the expansible-contractible thermal responsive material 60 through the walls of the container 48 by the ambient air or other element in contact with the container 48.

Under normal operating conditions the external leads 85 and 86 are connected in a control circuit so that the circuit is closed or opened according to the position of the container 48. Thus, under normal conditions as shown in Figure 1 the control circuit is closed between the external leads 85 and 86.

However, if heat is applied to the thermal responsive expansible-contractible material 60 by means of the electric heater element 62 or by means of transfer of heat through the walls of the container 48, the thermal responsive material 60 expands. Upon sufficient volumetric expansion of the expansible-contractible material 60, the elastic body 52 has such pressure applied thereto that the cavity within the elastic body 52 within which the rod member 20 extends is forced to partially close, as shown in Figure 2. As the cavity within the elastic body 52 begins to close, forces are applied to the container 48 and to the rod member 20 urging relative movement between the container 48 and the rod member 20. Due to the fact that the spring 30 has lesser resilient forces than the spring 72, the rod member 20 first moves and travels axially in a direction from the container 48. Such movement of the rod member further compresses the spring 30. As the expansible-contractible material 60 continues to expand, the rod member 20 continues to move axially until the head 22 of the rod member 20 engages the screw 24 which is attached to the transverse member 16 of the bracket 12.

When the head 22 of the rod member 20 engages the screw 24, further axial movement of the rod member 20 from the container 48 is prevented. Therefore, upon further expansion of the thermal responsive material 60 the container 48 moves while the rod member 20 remains in engagement with the screw 24. The container 48 moves along the rod member 20 away from the conductor ring 80, as shown in Figure 2. Such movement of the container 48 is against the resiliency of the helical spring 72.

When the container 48 moves from engagement with the conductor ring 80, the electric circuit between external leads 85 and 86 is opened.

The control circuit to which the external leads 85 and 86 are connected may be attached to means for energization of the electric heater element 62 within the thermal responsive material 60 so that when the container member 48 moves from engagement with the conductor ring 80 electrical energy ceases to flow into the electric heater element 62. In the use of this invention, the external conductor leads 85 and 86 may be connected to circuits, other than the connection leads 66 and 68, for control thereof by movement of the container 48.

The switch mechanism of this invention is not damaged if heat should continue to flow into the expansible-contractible material 60, causing further expansion thereof, after disengagement of the container 48 from the conductor plate 80. This is due to the fact that as the container

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48 continues to move in a direction from the conductor plate 80, additional forces are absorbed by the helical spring 72 as the spring 72 is further compressed.

Due to the fact that the expansible-contractible thermal responsive material 60 may be heated by either the electric heater 62 disposed within the thermal responsive material 60 or by means of a surrounding medium or an element which contacts the exterior of the container 48, the switch mechanism of this invention is applicable for controlling temperature or voltage or current.

In the use of the switch mechanism of this invention as a voltage regulator, the container 48 is maintained at a constant temperature while the connector leads 66 and 68 are attached to a source of voltage, the value of which is to be regulated. The external leads 85 and 86 are attached to means for controlling the source of electrical energy supplied to the connector leads 66 and 68. If the voltage applied across the connector leads 66 and 68 reaches an abnormally high value the current flow through the electric heater element 62 reaches an abnormally high value so that the heat supplied to the thermal responsive material 60 becomes excessive. This heat from the electric heater element 62 causes such expansion of the thermal responsive material 60 that the container 48 is forced to move from the conductor ring 80. When such movement of the container 48 from the conductor ring 80 occurs, the control circuit connecting to the external leads 85 and 86 is broken, causing a change in the control of the source of electrical energy to which the connector leads 66 and 68 are attached. In such manner the switch mechanism acts as a voltage regulator.

When the switch mechanism of this invention is employed as a temperature regulator, the container 48 is disposed in contact with a material or element, the temperature of which is to be controlled. The external leads 85 and 86 are attached to means for control of the heat or temperature of the material. The connector leads 66 and 68 may be attached to a source of constant voltage to provide a given amount of heat to the thermal responsive material 60, less than that necessary to operate the switch, so that only a small amount of external heat is necessary for operating the switch mechanism. If the temperature of the material with which the container 48 is in contact reaches an abnormally high value the container 48 is forced to move from the conductor ring 80, as discussed above. This movement of the container 48 opens the circuit between the external leads 85 and 86. Preferably the circuit of external leads 85 and 86 is connected to means for changing the amount of heat provided to the material or element in contact with the container. Thus, a substantially constant temperature of the material or element is maintained.

Thus, it is understood that the switch mechanism of this invention provides means for accurately opening and/or closing an electrical circuit. The point at which the electrical circuit is opened is easily and readily adjusted by means of adjustment of the screw member 24 and/or by adjustment of the energy provided to the heater element 62.

Modifications shown in Figures 3 and 4

In the modification shown in Figures 3 and 4, a main frame 90 slidably retains an auxiliary frame 92. A container member 94, similar to the container member 48 shown in Figures 1 and 2, has a body of thermal responsive material, such as the thermal responsive material 60, therein.

Slidably extending within the container 94 is a rod member 96 which is axially movable to engage a disc 98 which is attached to a threaded screw member 100. Compressed between the disc member 98 and a leg 102 of the auxiliary frame 92 is a helical spring 104. The rod member 96 has a collar 97 rigidly attached thereto. The collar 97 is engageable with the auxiliary frame 92 for movement thereof.

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Encircling the container 94 and in engagement therewith is a helical spring 108. The spring 108 is compressed between the container 94 and a leg 110 of the main frame 90. The spring 108 is larger and has greater compression forces than the spring 104.

Attached to the main frame 90 and extending laterally therefrom is a bracket 112. The bracket 112 supports a stationary contact finger 114 and a movable contact finger 116. The contact fingers 114 and 116 have an electric insulator member 118 therebetween at the ends thereof which are secured to the bracket 112 by means of an insulated bolt 120.

The movable contact finger 116 has attached thereto a contact 124 provided with a flexible lead 126 extending therefrom. The contact finger 114 has a contact 128 attached thereto provided with a flexible lead 130 extending therefrom. The contacts 124 and 128 are normally in engagement one with the other as shown in Figure 3.

The container 94 has an actuator arm 134 attached thereto which is engageable with the movable contact finger 116 for movement thereof from engagement with the contact finger 114, as shown in Figure 4.

Upon expansion of the expansible-contractible material within the container 94 the rod member 96 is axially moved toward the disc 98. Due to the fact that the compression spring 108 is a heavier and stronger spring than the compression spring 104, the container member 94 remains stationary as the rod member 96 moves outwardly from the container 94 toward the disc 98. The collar 97 which is attached to the rod member 96 forces upon the leg 102 of the auxiliary frame 92 so that the auxiliary frame 92 moves toward the disc 98 against the resilient forces of the spring 104.

The rod member 96 moves axially until there is engagement of the rod member 96 with the disc 98 preventing further movement thereof. Thus, movement of the auxiliary frame 92 toward the disc 98 is stopped. Upon further expansion of the thermal responsive material within the container 94, the container 94 is forced to move in a direction from the leg 102 of the auxiliary frame 92. This movement of the container member 94 is against the resilient action of the spring 108. The actuator arm 134 which is attached to the container member 94 engages the movable contact finger 116 moving the end of the contact finger 116 in a direction from the contact finger 114 so that the electric circuit between the contact fingers 114 and 116 is interrupted, as shown in Figure 4.

Although the preferred embodiment of the device has been described, it will be understood that within the purview of this invention various changes may be made in the form, details, proportion and arrangement of parts, the combination thereof and mode of operation, which generally stated consist in a device capable of carrying out the objects set forth, as disclosed and defined in the appended claims.

Having thus described my invention, I claim:

1. A thermal responsive switch comprising support structure, an axially movable rod member slidably carried by the support structure, a rigid container having an end wall provided with an aperture therethrough, a portion of the rod member being disposed within the container and slidably movable through the aperture of the end wall, thermal responsive expansible-contractible power transmitting material within the container, an electric contact plate carried by the support structure, a spring member carried by the support structure and the container urging the container into engagement with the electric contact plate, resilient means carried by the support structure and by the rod member urging the rod member in a direction toward the container, stop means carried by the rod member and the support structure limiting movement of the rod member in the direction from the container, a first electric conduit, the first electric conduit connecting to the spring member, the con-

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tainer having conductor means connecting the spring member to the electric contact plate when the container is in engagement with the contact plate, a second electric conduit, the second electric conduit being connected to the contact plate, insulator means electrically insulating the contact plate from the first electric conduit, there thus being electrical connection between the first electric conduit and the second electric conduit when the container is in engagement with the electric contact plate, expansion of the thermal responsive material within the container causing movement of the rod member in a direction from the container until further movement of the rod member is prevented by engagement thereof with the stop means, further expansion of the thermal responsive material causing movement of the container in a direction from the electric contact plate against pressure of the spring member so that electrical connection between the first electric conduit and the second electric conduit is broken.

2. A control mechanism comprising support structure, a frame movably carried by the support structure, the support structure having a leg disposed in spaced relation from the frame, a container member disposed between the leg and the frame, a helical spring compressed between the container member and the leg of the support structure, the container member having thermal responsive expansible-contractible material therein, a rod member slidably extending into the container member, the rod member also slidably extending through the frame, a collar rigidly attached to the rod member and engageable with the frame, resilient means engaging the frame and the collar urging the rod member toward the container member, switch means supported adjacent the container member, and actuator means carried by the container member engageable with the switch means for operation thereof.

3. A switch mechanism comprising support structure, electric conductor means carried by the support structure, a rod member carried by the support structure and axially movable with respect to the support structure, means limiting axial movement of the rod member, a rigid container member having an aperture therein, the container member being movably carried by the support structure, the rod member slidably extending into the container member through said aperture, electric conductor means movably carried by the container member and engageable with said electric conductor means which is carried by the support structure, spring means urging movement of the container member toward the electric conductor means which is carried by the support structure, spring means urging movement of the rod member toward the container member, thermal responsive work producing means within the container member operable upon the rod member to cause relative movement between the container member and the rod member, and heater means within the container member and within the thermal responsive means for heating the thermal responsive work producing means.

4. An electric switch mechanism comprising support structure, a rod member carried by the support structure, a rigid container member carried by the support structure, a portion of the rod member being slidably disposed within the container member, the container member being slidably carried by the rod member, electric conductor means carried by the support structure, electric conductor means movably carried by the container member and engageable with the electric conductor means carried by the support structure for closing of an electric circuit, the electric circuit being open when said electric conductor means are out of engagement, thermal responsive work producing means within the container member operable upon said portion of the rod member within the container member causing relative movement between the rod member and the container member, and heater means within the container member and within

the thermal responsive means for applying heat to the thermal responsive work producing means.

5. An electric switch mechanism comprising a support plate having an orifice therethrough, a bracket member attached to the support plate and extending therefrom at one side thereof, the bracket member being adjacent the orifice, an insulator member attached to the support plate at the side thereof opposite the bracket member, a bearing member carried by the insulator member in alignment with the orifice of the support plate, a retainer member attached to the support plate and to the insulator member and in engagement with the insulator member and extending therefrom, a rigid container member adjacent the retainer member, a spring member engaging the retainer member and the container member urging the container member toward the insulator member, a conductor plate attached to the insulator member, the container member having an end portion which is engageable with the conductor plate, said end portion of the container member being made of electrical conductive material, said spring member engaging said end portion of the container member, a rod member slidably carried by said bracket member, the rod member extending through the orifice of the support plate and slidably extending through the bearing member, an adjustable stop member carried by the bracket member and engageable by the rod member limiting the axial movement thereof, a resilient member carried by the rod member and by the bracket member urging movement of the rod member in a direction from the stop member, the rod member having a portion thereof extending into the container member, thermal responsive work producing material within the container member operable upon the rod member for causing relative movement between the rod member and the container member, heater means within the container member, a first electric conductor means, the first electric conductor means being attached to the retainer member, a second electric conductor means, the second electric conductor means being attached to the conductor plate.

6. A control assembly comprising support structure, a bracket movably carried by the support structure, a rod member carried by the bracket and axially movable with respect to the bracket, adjustable stop means carried by the support structure and engageable by the rod member limiting the axial movement thereof, spring means compressed between the bracket and the stop means urging the bracket in a direction from the stop means, a rigid container member having an aperture therein, the rod member slidably extending into the container member through the aperture therein, thermal responsive work producing means within the container member operable upon the rod member to cause relative movement between the rod member and the container member, the rod member having abutment means carried thereby engageable with the bracket for causing movement of the bracket toward the stop means, resilient means disposed between the support structure and the container member in engagement therewith urging the container member toward the bracket, electric switch means disposed adjacent the container member, switch actuator means carried by the container member and engageable with the switch means for operation thereof with movement of the container member.

7. A control mechanism comprising support structure, resilient means carried by the support structure, a container member movable with respect to the support structure and in engagement with the resilient means, a rod member partially disposed within the container member and slidably extending therefrom, the resilient means urging the container member toward the rod member, thermal responsive work producing means within the container member for causing relative movement between the container member and the rod member, resilient means urging the rod member toward the container member, means carried by the support structure limiting axial movement of the rod member, electric switch means engageable by the container member and operable by movement of the container member, heater means within the work producing means, and conductor means connecting the switch means to the heater means.

8. A control mechanism comprising support structure, resilient means carried by the support structure, a container member in engagement with the resilient means, a rod member within the container member and slidably extending therefrom, thermal responsive work producing material within the container member operable upon the rod member causing relative movement between the container member and the rod member, a collar rigidly attached to the rod member and movable therewith, a movable wall member provided with an aperture therethrough, the rod member extending through the aperture of the movable wall member, the collar of the rod member engaging the wall member for movement thereof with movement of the rod member, a spring member engaging the wall member urging the wall member toward the collar, switch means carried by the support structure, and means carried by the container member for operation of the switch means.

9. A control mechanism comprising support structure, resilient means carried by the support structure, a container member in engagement with the resilient means, a rod member within the container member and slidably extending therefrom, thermal responsive work producing material within the container member operable upon the rod member causing relative movement between the container member and the rod member, a collar rigidly attached to the rod member and movable therewith, a movable wall member provided with an aperture therethrough, the rod member extending through the aperture, the collar of the rod member engaging the wall member for movement thereof, a spring member engaging the wall member urging the wall member toward the collar, electric circuit means carried by the support structure, circuit breaking means carried by the container member and operable therewith.

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